CLAIMS

We Claim:

- [c01] A method for reducing the time required for analyzing at least one sample for a parameter of interest which comprises collecting analytical data from a sample using a predetermined integration time T_a and applying mathematical transform analysis on the data, wherein the mathematical transform analysis is performed using conditions designed to achieve a pre-determined signal quality response function value comprising the value obtained when samples are analyzed without mathematical transform analysis using integration time T_b , wherein T_b is greater than T_a .
- [c02] The method of claim 1, wherein the mathematical transform analysis comprises multivariate analysis.
- [c03] The method of claim 2, wherein the multivariate analysis comprises neural networks analysis, principal components analysis, partial least squares analysis, linear multivariate analysis, or nonlinear multivariate analysis.
- [c04] The method of claim 1, wherein the mathematical transform analysis comprises discrete transform analysis.
- [c05] The method of claim 1, wherein the mathematical transform analysis comprises continuous transform analysis.
- [c06] The method of claim 1, wherein the mathematical transform analysis comprises time averaging analysis, smoothing analysis or Savitsky-Golay analysis.
- [c07] The method of claim 1, wherein the mathematical transform analysis comprises Fourier transform, Gabor transform, or Hadamard transform.
- [c08] The method of claim 1, wherein the mathematical transform analysis comprises wavelet transform.

- [c09] The method of claim 8, wherein the wavelet transform analysis comprises a wavelet de-noising algorithm.
- [c10] The method of claim 9, wherein the wavelet de-noising algorithm comprises wavelet filters.
- [c11] The method of claim 9, wherein the wavelet de-noising algorithm comprises a threshold/shrinkage method.
- [c12] The method of claim 1, wherein parameters of the mathematical transform are determined during the course of analysis.
- [c13] The method of claim 1, wherein the pre-determined signal quality response function comprises one or more measured signal parameters.
- [c14] The method of claim 13, wherein at least one of the measured signal parameters comprises signal resolution.
- [c15] The method of claim 13, wherein at least one of the measured signal parameters comprises peak shift.
- [c16] The method of claim 13, wherein at least one of the measured signal parameters comprises signal distortion.
- [c17] The method of claim 13, wherein at least one of the measured signal parameters comprises a signal-to-noise ratio.
- [c18] The method of claim 17, wherein the signal-to-noise ratio ranges from 1 to 10,000.
- [c19] The method of claim 17, wherein the signal-to-noise ratio ranges from 2 to 5,000.
- [c20] The method of claim 17, wherein the signal-to-noise ratio ranges from 3 to 1,000.

- [c21] The method of claim 1, wherein the analytical data comprises a first-order array.
- [c22] The method of claim 1, wherein the analytical data comprises a second-order or higher array.
- [c23] The method of claim 1, wherein the analytical data comprise spectroscopic, imaging, sensor, or scanning data.
- [c24] The method of claim 23, wherein the data further comprise measurements made using Raman, luminescence, ultraviolet-visible molecular absorbance, atomic absorbance, infra-red, near infrared, surface plasmon resonance, mass spectrometry, X-ray, nuclear magnetic resonance, refractometry, interferometry, scattering, inductively coupled plasma, atomic force microscopy, scanning tunneling microscopy, microwave evanescent wave microscopy, near-field scanning optical microscopy, atomic fluorescence, laser-induced breakdown spectroscopy, Auger electron spectroscopy, X-ray photoelectron spectroscopy, ultrasonic spectroscopy, dielectric spectroscopy, microwave spectroscopy, resonance-enhanced multiphoton ionization, or combinations thereof.
- [c25] The method of claim 23, wherein the data further comprise measurements made using photon probe microscopy, electron probe microscopy, ion probe microscopy, field probe microscopy, or scanning probe microscopy techniques.
- [c26] The method of claim 1, wherein analytical data is provided using techniques relying on collection of electromagnetic radiation in the range from 0.05 Angstroms to 500 millimeters (mm).
- [c27] The method of claim 1, wherein the sample comprises inorganic material, organic material, polymeric material, biological material, or combinations thereof.
- [c28] The method of claim 1, wherein the parameter of interest is determined in the range from a single molecule to up to 100% of the sample.

- [c29] Computer readable media comprising software code for performing the method of claim 1.
- [c30] A method for reducing the time required for analyzing at least one sample for a parameter of interest which comprises:

selecting a pre-determined signal quality response function;

selecting a pre-determined integration time Ta;

collecting analytical data from a sample with integration time T_a;

applying a screening rate accelerator toolbox comprising mathematical transform analysis to the data, wherein the mathematical transform analysis is performed using conditions designed to achieve a pre-determined signal quality response function value comprising the value obtained when samples are analyzed without mathematical transform analysis using integration time T_b , wherein T_b is greater than T_a ; and

analyzing the data processed by the screening rate accelerator toolbox for the parameter of interest.

- [c31] The method of claim 30, wherein the mathematical transform analysis comprises multivariate analysis.
- [c32] The method of claim 31, wherein the multivariate analysis comprises neural networks analysis, principal components analysis, partial least squares analysis, linear multivariate analysis, or nonlinear multivariate analysis.
- [c33] The method of claim 30, wherein the mathematical transform analysis comprises discrete transform analysis.
- [c34] The method of claim 30, wherein the mathematical transform analysis comprises continuous transform analysis.
- [c35] The method of claim 30, wherein the mathematical analysis comprises time averaging analysis, smoothing analysis or Savitsky-Golay analysis.
- [c36] The method of claim 30, wherein the mathematical transform analysis comprises Fourier transform, Gabor transform, or Hadamard transform.

- [c37] The method of claim 30, wherein the mathematical transform analysis comprises wavelet transform.
- [c38] The method of claim 37, wherein the wavelet transform analysis comprises a wavelet de-noising algorithm.
- [c39] The method of claim 38, wherein the wavelet de-noising algorithm comprises wavelet filters.
- [c40] The method of claim 38, wherein the wavelet de-noising algorithm comprises a threshold/shrinkage method.
- [c41] The method of claim 30, wherein parameters of the mathematical transform are determined during the course of analysis.
- [c42] The method of claim 30, further comprising determining whether the analytical data collected from the sample with integration time T_a satisfies the predetermined signal quality response function value prior to applying the screening rate accelerator toolbox and applying the screening rate accelerator toolbox if the collected data does not satisfy the pre-determined signal quality response function value, but not if the collected data does satisfy the pre-determined signal quality response function value.
- [c43] The method of claim 30, further comprising the steps of:

determining whether the data processed by the screening rate accelerator toolbox satisfies the pre-determined signal quality response function value; and

if the processed data does not satisfy the pre-determined signal quality response value, re-applying the screening rate accelerator toolbox using a mathematical transform analysis different from the analysis previously applied until the data processed using the screen rate accelerator toolbox either satisfies the pre-determined signal quality response function value or comprises an optimized signal quality response function value.

- [c44] The method of claim 43, further comprising repeating the method with a new, larger value for T_a if the data which is optimized using the screening rate accelerator toolbox does not satisfy the pre-determined signal quality response function value.
- [c45] The method of claim 30, wherein if the collected data does not require application of the screening rate accelerator toolbox to satisfy a pre-determined signal quality response function value, a shorter pre-determined integration time T_a is selected, and the method is performed using the new value for T_a .
- [c46] The method of claim 30, wherein the preset signal quality response function comprises one or more measured signal parameters.
- [c47] The method of claim 46, wherein at least one of the measured signal parameters comprises signal resolution.
- [c48] The method of claim 46, wherein at least one of the measured signal parameters comprises peak shift.
- [c49] The method of claim 46, wherein at least one of the measured signal parameters comprises signal distortion.
- [c50] The method of claim 46, wherein at least one of the measured signal parameters comprises a signal-to-noise ratio.
- [c51] The method of claim 50, wherein the signal to noise ratio ranges from 1 to about 10,000.
- [c52] The method of claim 50, wherein the signal to noise ratio ranges from 2 to 5,000.
- [c53] The method of claim 50, wherein the signal to noise ratio ranges from 3 to 1,000.
- [c54] The method of claim 30, wherein the relative improvement in signal integration time (T_b/T_a) ranges from about 1.5 to 1,000 fold.

- [c55] The method of claim 30, wherein the relative improvement in signal integration time (T_b/T_a) ranges from about 1.5 to 500 fold.
- [c56] The method of claim 30, wherein the relative improvement in signal integration time (T_b/T_a) ranges from about 1.5 to 200 fold.
- [c57] The method of claim 30, wherein the analytical data comprises a first-order array.
- [c58] The method of claim 30, wherein the analytical data comprises a multi-order array.
- [c59] The method of claim 30, further comprising simultaneous evaluation of each individual sample in an array of samples.
- [c60] The method of claim 30, wherein the analytical data comprise spectroscopic, imaging, sensor, or scanning data.
- [c61] The method of claim 60, wherein the data further comprise measurements made using Raman, luminescence, ultraviolet-visible molecular absorbance, atomic absorbance, infra-red, near infrared, surface plasmon resonance, mass spectrometry, X-ray, nuclear magnetic resonance, refractometry, interferometry, scattering, inductively coupled plasma, atomic force microscopy, scanning tunneling microscopy, microwave evanescent wave microscopy, near-field scanning optical microscopy, atomic fluorescence, laser-induced breakdown spectroscopy, Auger electron spectroscopy, X-ray photoelectron spectroscopy, ultrasonic spectroscopy, dielectric spectroscopy, microwave spectroscopy, resonance-enhanced multiphoton ionization, or combinations thereof.
- [c62] The method of claim 60, wherein the data further comprise measurements made using photon probe microscopy, electron probe microscopy, ion probe microscopy, field probe microscopy, or scanning probe microscopy techniques.

- [c63] The method of claim 30, wherein analytical data is provided using techniques relying on collection of electromagnetic radiation in the range from 0.05 Angstroms to 500 millimeters (mm).
- [c64] The method of claim 30, wherein the sample comprises inorganic material, organic material, polymeric material, biological material, or combinations thereof.
- [c65] The method of claim 30, wherein the parameter of interest ranges from a single molecule to up to 100% of the sample.
- [c66] The method of claim 30, wherein the sample comprises polycarbonate.
- [c67] Computer readable media comprising software code for performing the method of claim 30.
- [c68] An apparatus for analyzing at least one sample for a parameter of interest using a pre-determined signal quality response function which comprises:
- a collecting system for collecting analytical data comprising the parameter of interest from a sample;
 - a processing system for processing the analytical data;
- a screening rate accelerator toolbox for applying mathematical transform analysis to the data;
- a data analysis system for determining whether the data processed by the screening rate accelerator toolbox satisfies a pre-determined signal quality response function value; and
- a statistical toolbox for analyzing the processed data for the parameter of interest.
- [c69] The apparatus of claim 68, wherein the mathematical transform analysis comprises multivariate analysis.
- [c70] The apparatus of claim 69, wherein the multivariate analysis comprises neural networks analysis, principal components analysis, partial least squares analysis, linear multivariate analysis, or nonlinear multivariate analysis.

- [c71] The apparatus of claim 68, wherein the mathematical transform analysis comprises discrete transform analysis.
- [c72] The apparatus of claim 68, wherein the mathematical transform analysis comprises continuous transform analysis.
- [c73] The apparatus of claim 68, wherein the mathematical analysis comprises time averaging analysis, smoothing analysis or Savitsky-Golay analysis.
- [c74] The apparatus of claim 68, wherein the mathematical transform analysis comprises Fourier transform, Gabor transform, or Hadamard transform.
- [c75] The apparatus of claim 68, wherein the mathematical transform analysis comprises wavelet transform.
- [c76] The apparatus of claim 68, wherein the parameters of the mathematical transform are determined during the course of analysis.
- [c77] The apparatus of claim 68, wherein the preset signal quality response function comprises one or more measured signal parameters.
- [c78] The apparatus of claim 77, wherein at least one of the measured signal parameters comprises a signal-to-noise ratio.
- [c79] The apparatus of claim 77, wherein at least one of the measured signal parameters comprises signal resolution.
- [c80] The apparatus of claim 77, wherein at least one of the measured signal parameters comprises signal distortion.
- [c81] The apparatus of claim 77, wherein at least one of the measured signal parameters comprise peak shift.
- [c82] The apparatus of claim 68, further comprising at least one energy source for interacting with a sample.

- [c83] The apparatus of claim 82, wherein the energy source comprises a light source, an ion source, or a radiation source.
- [c84] The apparatus of claim 68, wherein the collecting system comprises an optical spectrometer, an ion spectrometer, a mass detector, or an imaging camera.
- [c85] The apparatus of claim 68, wherein the analytical data comprises a first-order array.
- [c86] The apparatus of claim 68, wherein the analytical data comprises a multiorder array.
- [c87] The apparatus of claim 68, further comprising simultaneous evaluation of each individual sample in an array of samples.
- [c88] The apparatus of claim 68, wherein the analytical data comprise spectroscopic, imaging, scanning, and sensor data.
- [c89] The apparatus of claim 88, wherein the data further comprise measurements made using Raman, luminescence, ultraviolet-visible molecular absorbance, atomic absorbance, infra-red, near infrared, surface plasmon resonance, mass spectrometry, X-ray, nuclear magnetic resonance, refractometry, interferometry, scattering, inductively coupled plasma, atomic force microscopy, scanning tunneling microscopy, microwave evanescent wave microscopy, near-field scanning optical microscopy, atomic fluorescence, laser-induced breakdown, Auger electron spectroscopy, X-ray photoelectron spectroscopy, ultrasonic spectroscopy, dielectric spectroscopy, microwave spectroscopy, resonance-enhanced multiphoton ionization, or combinations thereof.
- [c90] The apparatus of claim 88, wherein the data further comprise measurements made using photon probe microscopy, electron probe microscopy, ion probe microscopy, field probe microscopy, or scanning probe microscopy techniques.

[c91] The apparatus of claim 68, wherein analytical data is provided using techniques relying on collection of electromagnetic radiation in the range from 0.05 Angstroms to 500 millimeters (mm).

[c92] The apparatus of claim 68, further comprising computer readable media comprising software code.